

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2015/2016

EET 2066 - POWER TECHNOLOGY (RE)

30 MAY 2016
2.30 p.m. - 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of 4 pages including cover page with 3 Questions only.
2. Attempt **ALL** questions. The distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

QUESTION 1

- a) Two 12V batteries are to be charged using a 30V DC source with a rated current of 5A. Draw a circuit diagram showing the charging arrangement. Include protective measures such that the current drawn from the source does not exceed the rated current. (4)
- b) When a 10Ω resistor is connected across the terminals of a 6V battery, the voltage across the resistor was 5.8V. Determine the internal resistance of the battery. (4)
- c) A stepper motor has a step angle of 1.2° . It is driven at a rate of 2000 pulses/s. Determine the rotor speed in rpm and the number of pulses to be applied to rotate the rotor through 60° . (5)
- d) A stepper motor has 5 stator poles. Determine the number of rotor poles required to obtain a step angle of 3.6° for i) unipolar winding and ii) bipolar winding. (5)
- e) A power BJT switching circuit with inductive load has the following parameters:
 $V_{CC} = 150\text{ V}$; Collector-emitter leakage current = 3 mA; Collector-emitter saturation voltage = 1.2V; On-state collector current = 20A; Switching frequency = 10 kHz; Duty cycle = 0.6; Turn-on time = $0.8\text{ }\mu\text{s}$; Turn-off time = $1.2\text{ }\mu\text{s}$.
- i) Draw the circuit diagram of the switching circuit. (4)
- ii) Calculate the on-state power loss. (4)
- iii) Calculate the off-state power loss. (3)
- iv) Calculate the dynamic loss. (4)
- v) Calculate the total power loss. (2)

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QUESTION 2

- a) A single phase full wave diode bridge rectifier operating from a 120V, 60 Hz supply, delivers a current of 15A to a purely resistive load. Assume ideal diodes and negligible source inductance.
- Draw the circuit diagram of the rectifier. (3)
 - Sketch the waveforms of output voltage, output current, source current. (6)
 - Calculate the average output voltage and percentage ripple. (4)
 - Explain how the percentage ripple can be reduced. (2)
- b) Compare fly-back DC-DC converter and boost DC-DC converter with respect to (i) input-output electrical isolation (ii) input-output polarity and (iii) buck operation. (3)
- c) A DC-DC boost converter operates at a switching frequency of 15 kHz and a duty cycle of 0.7. The source voltage is 12 V and load resistance is 10Ω . The inductance is 1 mH. $C = 220\mu\text{F}$. Assume ideal diode and switch.
- Draw the circuit diagram of the converter and sketch the wave-forms of inductor voltage and inductor current. (8)
 - Calculate the output voltage and its percentage ripple. (4)

Continued...

QUESTION 3

- a) A single phase 50 Hz full-bridge voltage-source inverter with a square wave output feeds power to a RL load. The DC supply voltage (V_s) is 220V. The expression for the output voltage across the load is given by

$$v(\omega t) = \sum_{n=1,3,5}^{\infty} \frac{4V_s}{n\pi} \sin n\omega t$$

- i. Draw the complete circuit diagram of the inverter and state the sequence of operation of switches. (5)
 - ii. Sketch the waveforms of load voltage, load current and fundamental component of load current. (6)
 - iii. Calculate the total harmonic distortion (THD) in the output voltage wave form. (4)
- b) With the help of a block diagram, explain the operation of an uninterrupted power supply (UPS). (10)
- c) Draw the steady state equivalent circuit of a permanent magnet DC motor and explain how variable speeds can be obtained by voltage control. Sketch the torque-speed characteristics with variable armature supply voltage. (10)

End of Paper